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Idle Fuel Consumption in Passenger Cars

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Technology Assessment and Evaluation Branch
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
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The Environmental Protection Agency has received numerous requests for idle fuel consumption data. The purpose of this report is to provide data which can be used to calculate the energy impact of various actions taken to reduce vehicle time spent at idle.

The conclusions drawn from the test data are necessarily of limited applicability. The data base includes only late model vehicles. A complete evaluation of the energy impact of actions taken to reduce vehicle idle time requires more vehicle models and a larger sample of these test vehicles than is included in the data base.

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Background

The Environmental Protection Agency has received numerous requests for idle fuel consumption data. The purpose of this report is to provide data which can be used to calculate the energy impact of various actions taken to reduce vehicle time spent at idle.

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Vehicles Tested

EPA conducts surveys of the sources and causes of air pollution, including light duty vehicle emissions, the results of which are used to calculate and predict emissions on a national and local basis. Idle fuel economy for 1972-74 vehicles was a by-product of a recently conducted survey of passenger car exhaust emissions.

The vehicles tested, passenger cars using the conventional gasoline engine, were selected on the basis of mileage, make, and age to be representative of in-use vehicles. Vehicle weights ranged from 2000 to 5500 pounds. The vehicles were checked for exhaust leaks and safety, and were tested in the as received condition.

In addition to the in-use vehicles, several production cars using diesel or stratified charge engines (Mercedes-Benz Diesel, Peugeot Diesel, Honda CVCC Civic) have been tested at the EPA emissions laboratory. A few experimental steam and gas turbine powered cars were also tested. All vehicles tested at the EPA laboratory were properly tuned prior to testing. Data for two of the steam cars came from tests conducted outside EPA sponsorship (see Table III).

Test Procedure

Vehicle exhaust emission tests were conducted using methods similar to the 1975 Federal Test Procedure (1975 FTP). After the vehicle had stabilized at idle, a diluted exhaust sample was drawn off and analyzed. Idle mass emissions were calculated from the mass flow rate and pollutant concentrations of the diluted vehicle exhaust. Fuel consumption was calculated by a carbon balance method, which equates the carbon in the fuel to the carbon in the emission products.

Test Results

The results of tests for vehicles in the Denver, Detroit, and Houston areas were:

Average Idle Mass Emissions
grams per minute

	HC	CO	NOx	Fuel Consumption
1972 Vehicles	.94	18.6	.38	.82 gallons/hr.
1973 Vehicles	.88	15.4	.15	.80 gallons/hr.
1974 Vehicles	.86	13.2	.20	.85 gallons/hr.
All Vehicles	.90	16.4	.25	.82 gallons/hr.

The sales-weighted idle fuel consumption was .82 gallons per hour. The average idle fuel consumption ranged from .4 gallons per hour for light vehicles with small engines to 1.2 gallons per hour for heavy vehicles with large engines. The results are tabulated in Tables 1 and 2 and plotted in Figures 1 and 2.

Vehicle inertia weight categories were selected according to the 1975 FTP. Vehicle engine displacement categories were selected to place the most popular engine sizes (i.e., 250, 307, 350, 400 and 455 CID) in spearate categories.

For each engine displacement or vehicle weight category the idle fuel consumption mean (x) and standard deviation (s) were calculated (Table 1 and 2). The considerable variability in vehicle-to-vehicle idle fuel consumption is evident from the magnitude of the standard deviation (15 to 65% of the mean). This large variability is most likely caused by differences in idle speed, idle air/fuel ratio and idle spark timing.

A linear regression analysis of the graphs of Figures 1 and 2 shows a correlation between idle fuel consumption, vehicle weight, and CID. Idle fuel consumption increased .16 gallons per hour for each 100 cubic inch increase in engine displacement. Because heavier vehicles tend to use larger engines, idle fuel consumption increased .21 gallons per hour for each 1000 pound increase in vehicle weight.

The results for vehicles using the non-standard engines are tabulated in Table III and plotted in Figures 1 and 2. The diesel and stratified charge vhicles had significantly lower idle fuel consumption than the conventional vheicles.

The wide variation in fuel consumption for the two TCCS vehicles was the result of the approaches used to control emissions.

The Texaco TCCS jeep is known to be capable of much lower fuel consumption levels, but at a very high level of HC. The technique used to obtain low HC levels is to increase the exhaust temperature during idle and light load conditions by throttling the intake air. This can cause substantial increases in fuel consumption. However the TCCS Cricket was not equipped with EGR as this vehicle was set up for optimum fuel economy with less attention to low NOx emissions.

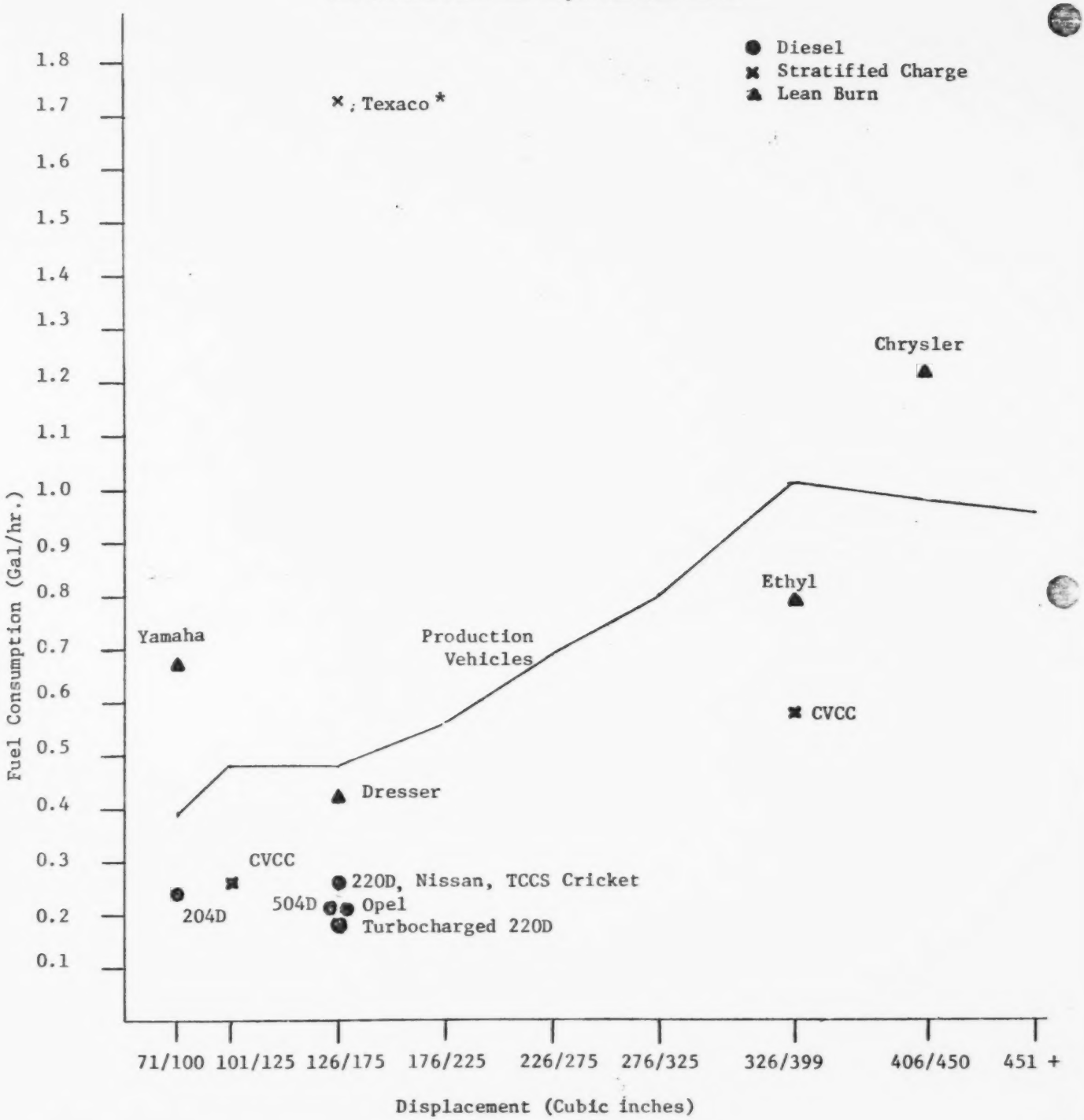
The variations in fuel consumption among the steam cars were due to the design approaches. The Carter vehicle was an experimental low emission vehicle with performance comparable to conventional vehicles. The Aerojet and SPS vehicles were experimental vehicles designed to demonstrate the lowest emission levels achieveable with present Rankine cycle technology.

Conclusions

The sales-weighted idle fuel consumption for 1972 to 1974 vehicles is .82 gallons per hour. Because heavier vehicles tend to use larger engines, idle fuel consumption ranges from .4 gallons per hour for light vehicles with small engines to 1.2 gallons per hour for heavy vehicles with large engines. The idle fuel consumption penalty is .16 gallons per hour for each 100 cubic inch increase in engine size.

Figure 1

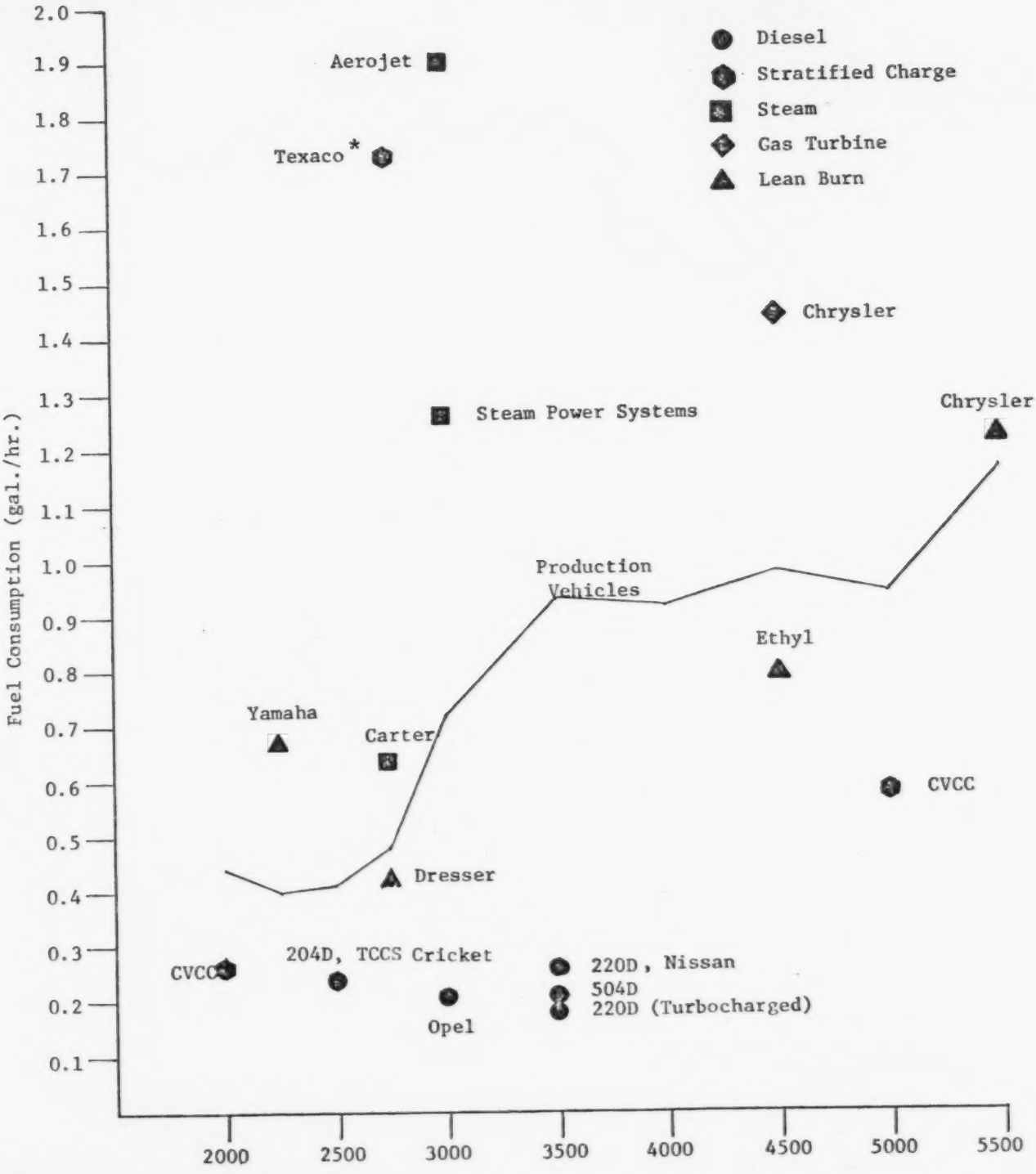
Idle Fuel Consumption vs. Engine Displacement
For Production and Experimental Cars



* See text on TCCS

Figure 2

Idle Fuel Consumption vs. Weight
For Production and Experimental Cars



* See text on TCCS

Table I

Idle Fuel Consumption vs. Engine Displacement

Displacement cubic inches	Number of Vehicles	Idle Fuel Consumption - Gallons/Hour			
		Mean	Standard Deviation	Range Low	Range High
71-100	21	.39	.17	.20	.80
101-125	16	.48	.31	.20	1.34
126-175	10	.48	.21	.26	1.01
176-225	8	.56	.17	.32	.78
226-275	8	.69	.34	.28	1.43
276-325	36	.80	.25	.44	1.34
326-399	64	1.01	.44	.39	3.43
400-450	35	.98	.34	.46	1.92
451 & above	24	.96	.23	.57	1.67

Table II

Idle Fuel Consumption vs. Inertia Weight

Inertia Weight Pounds	Number of Vehicles	Idle Fuel Consumption - Gallons/Hour			
		Mean	Standard Deviation	Range Low	Range High
2000	5	.44	.22	.21	.80
2250	13	.40	.16	.20	.71
2500	21	.41	.19	.20	1.01
2750	7	.48	.23	.28	.95
3000	23	.72	.38	.28	1.48
3500	31	.93	.55	.45	1.91
4000	48	.92	.23	.39	1.91
4500	51	.98	.32	.52	1.95
5000	19	.94	.23	.50	1.36
5500	4	1.16	.36	.88	1.67

Note: The above trend is obviously one of engine size not vehicle weight because heavier vehicles tend to use larger engines.

Table III

Idle Fuel Consumption

Vehicle	Displacement cubic inches	Inertia Weight pounds	Idle Fuel Consumption gallons/hour
Aerojet Steam (Vega)*	N/A	3000	1.90
Carter Steam (VW)	N/A	2750	.64
Chrysler Turbine (Satellite)	N/A	4500	1.44
Dresser (Capri)	159	2750	.42
Honda CVCC (Civic-stratified)	119	2000	.26
Honda CVCC (Impala-stratified)	350	5000	.58
Mercedes Benz (Turbocharged 220 Diesel)	134	3500	.18
Mercedes Benz (220 Diesel)	134	3500	.26
Nissan Diesel**	131	3500	.13
Opel Rekord (2100 Diesel)	126	3000	.21
Peugeot 204D (Diesel)	83	2500	.24
Peugeot 504D (Diesel)	129	3500	.21
Steam Power Systems*	N/A	3000	1.26
Texaco TCCS (M-151, Jeep) (Stratified)	141	2750	1.73
Yamaha Lean Combustion System (Corolla)	97	2250	.67
Ethyl Lean Burn	360	4500	.79
Chrysler Lean Burn	440	5500	1.22
TCCS Cricket (Diesel)**	141	2500	.24
(Gasoline)**			.24

* Not EPA test data

** EPA sponsored test, not at EPA laboratory